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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/776,329	02/02/2001	Sean M. Seutter	AMAT/5192/ISM/CORE MCVD/S	9575
32588	7590	06/04/2004	EXAMINER THOMAS, TONIAE M	
APPLIED MATERIALS, INC. 2881 SCOTT BLVD. M/S 2061 SANTA CLARA, CA 95050			ART UNIT 2822	PAPER NUMBER

DATE MAILED: 06/04/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/776,329

Applicant(s)SEUTTER ET AL. **Examiner**

Toniae M. Thomas

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 18 March 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,2,4-8,11-23,32-36,38-47 and 51-58 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 4-8,16-23,32-34,38-44 and 58 is/are allowed.
- 6) ☒ Claim(s) 1,2,11-15,35,36,45-47,51-55 and 57 is/are rejected.
- 7) ☒ Claim(s) 56 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 27 April 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

1. This action is responsive to the amendment filed on 18 May 2004. Currently, 1, 2, 4-8, 11-23, 32-36, 38-47, 51-58 *are pending.*
2. The indicated allowability of claims 1, 2, 11-15, 35, 36, and 45-47 is withdrawn in view of the newly discovered reference to Chiang et al. (6,416,822 B1). Rejections based on the newly cited reference follow.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. *Claims 1, 2, 11-15, 35, 36, 51-55, and 57 are rejected under 35 U.S.C. 102(e) as being anticipated by Chiang et al. (US 6,416,822 B1).*

Regarding claims 1, 2, and 35

The Chiang et al. patent (Chiang) discloses a method of deposition (col. 8, line 29 – col. 10, line 13). The method comprises: providing a wafer to a chamber; providing a plasma source gas containing nitrogen to the chamber; igniting the plasma source gas to provide a plasma; providing a tantalum containing gas to the chamber; and co-reacting

the tantalum-containing gas and the plasma to chemisorb on a wafer surface a tantalum-nitride layer (col. 9, lines 4-50).

The first precursor and the second precursor are delivered sequentially to form the tantalum-nitride film (col. 9, lines 4-50).

Regarding claims 11-15, 51-55, and 57

Chiang discloses a method of film deposition, wherein the method comprises: providing a process system, the process system having a chamber; locating a substrate in the process chamber; chemisorbing a first tantalum layer on the substrate in response to the first reactive gas; conditioning the chamber with at least one of a purge gas or an evacuation; providing a second reactive gas to the chamber; and chemisorbing the second reactive gas, the second layer different from the first layer, the second layer selected from a nitride layer and a second tantalum layer, wherein the tantalum-containing gas is a tantalum based organo-metallic precursor or derivative thereof (col. 9, lines 4-43).

The substrate is maintained at temperature below the thermal decomposition temperature of the tantalum-containing gas (col. 8, lines 31-38).

Regarding claim 36

Chiang discloses a method of film deposition, wherein the method comprises: providing a chamber; providing a plasma source gas containing nitrogen to the chamber; igniting the plasma source gas to provide a plasma; chemisorbing a nitrogen layer on a substrate; providing a precursor gas containing tantalum to the chamber; and

chemisorbing a tantalum layer on the substrate, wherein the nitrogen layer and tantalum layer in combination provide a tantalum-nitride layer (col. 9, lines 4-43).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. *Claims 45-47 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nogami et al. (US 6,001,415 B1) in view of Chiang (6,416,822 B1).*

The Nogami et al. patent (Nogami) discloses a method of forming a barrier layer structure and interconnect structure (figs. 1-7 and accompanying text). The method comprises: providing a substrate having an oxide layer 24 thereon, wherein the dielectric layer has a recess formed to expose a portion of a surface of the substrate (fig. 3); forming a barrier layer 42 on the dielectric layer and the substrate, wherein the barrier layer may comprise tantalum nitride (fig. 4 and col. 3, lines 54-62); etching through portions of the tantalum nitride layer (fig. 5); depositing a metal layer 62 of copper in the recess (fig. 6 and col. 4, lines 22-31), wherein the barrier layer prevents the migration of copper from the metal to the dielectric layer (col. 4, lines 46-52).

In the instance when tantalum nitride is used as the barrier layer 42, Nogami al. does not teach depositing the tantalum nitride layer using a co-reaction chemisorption of tantalum containing and nitrogen containing precursor gases.

Chiang teaches a method of depositing a film using a co-reaction chemisorption method (col. 9, line 44 - col. 10, line 13).

Since Nogami and Chiang are from the same field of endeavor, the purpose disclosed by Chiang would have been recognized in the pertinent reference of Nogami by one of ordinary skill in the art at the time the invention was made.

One having ordinary skill in the art would have been motivated to modify Nogami by forming the tantalum nitride layer 42 using a co-reacting chemisorption of tantalum containing and nitrogen containing precursor gases, as taught by Chiang et al., because this method is faster than sequential chemisorption (Chiang - col. 9, lines 44-50).

Allowable Subject Matter

5. Claims 4-8, 16-23, 32-34, 38-44, and 58 are allowed. Claim 56 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. Claims 4-8, 16-23, 32-34, and 38-44 are allowed because the prior art of record does not anticipate, teach, or suggest a method of film deposition substantially as claimed wherein the method comprises a plasma annealing step. Claim 58 is allowable because the prior art of record does not anticipate, teach, or suggest a method of film

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deposition substantially as claimed wherein the method comprises maintaining the substrate above a thermal decomposition temperature of the tantalum-containing gas.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Toniae M. Thomas whose telephone number is (571) 272-1846. The examiner can normally be reached on Monday-Thursday from 8:30 AM to 5:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on (571) 272-1852. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

MMJ

01 June 2004



Mary Wilczewski
Primary Examiner